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## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification <sup>3</sup> : F21P 3/00; A63J 17/00; G09F 27/00		A1	(11) International Publication Number: WO 81/01602 (43) International Publication Date: 11 June 1981 (11.06.81)
(21) International Application Number: PCT/GB79/00201 (22) International Filing Date: 27 November 1979 (27.11.79)			(81) Designated States: DK, JP, US.  Published <i>With international search report</i>
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(54) Title: AUDIO-VISUAL DISPLAY SYSTEM			
(57) Abstract			
<p>An audio-visual display system has a number of channels each giving an electrical output in response to a selected audio-frequency input. Different lamps (18) are connected to the outputs of the channels and project coloured images onto a screen (14). To provide an enhanced visual effect the images are projected across the surface of a concave screen, preferably from the screen periphery. Some lamps incorporate non-laminar light-transmitting elements (22) which give patterned images by refraction or from striations in the element, preferably in the middle to higher frequency range. The highest and lowest frequencies are preferably in the central region of the display. The lamps are preferably arranged in rows (X, Y, Z) at different distances from the screen.</p>			

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<p>(54) Title: AUDIO-VISUAL DISPLAY SYSTEM</p>		
<p>(57) Abstract</p> <p>An audio-visual display system has a number of channels each giving an electrical output in response to a selected audio-frequency input. Different lamps (18) are connected to the outputs of the channels and project coloured images onto a screen (14). To provide an enhanced visual effect the images are projected across the surface of a concave screen, preferably from the screen periphery. Some lamps incorporate non-laminar light-transmitting elements (22) which give patterned images by refraction or from striations in the element, preferably in the middle to higher frequency range. The highest and lowest frequencies are preferably in the central region of the display. The lamps are preferably arranged in rows (X, Y, Z) at different distances from the screen.</p>		

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1.

AUDIO-VISUAL DISPLAY SYSTEM

This invention relates to audio-visual display systems, and more particularly to systems in which the 5 production of music or other sound is accompanied by the production of images on a screen in response to the sound.

An audio-visual display system of this kind may comprise a plurality of channels each having a filter unit to provide an electrical output signal in response 10 to a selected band of audio frequency input, the different channels being responsive to different bands and connected to separate lamps or sets of lamps which are arranged to project different images on a screen, whereby the different images are produced in response to 15 variations in audio frequencies supplied to the filter units.

An important part of the system of the present invention is the final display part, since the quality of the system will be judged by the subjective impression 20 of the images which the viewer receives. It has been found that a particularly desirable effect is produced by using a concave screen, preferably parabolic, and arranging the lamps to project the images across the concave surface, preferably from the periphery of the 25 screen. The lamps are preferably arranged around a



2.

sector of the periphery, whereby the images appear to emanate from that sector. However, they could be arranged at the centre of the screen so as to radiate the light outwardly across the surface.

- 5        At least some of the lamps preferably incorporate non-laminar coloured light-transmitting elements of glass, crystal, or preferably gemstones, through which the light passes so as to provide coloured patterned images by refraction or from natural internal striations
- 10      in the element. Preferably the lamps are of at least two sorts; one sort incorporating elements as described above, and another sort providing a relatively diffuse image by transmission of light through coloured sheet filters (the sheet being separate from the lamp or part
- 15      of the lamp envelope itself). Another sort of lamp may provide coloured light emanating from one or more openings in a generally opaque lamp housing the openings being small in relation to the lamp so as to provide relatively narrow beams of light. The lamps are
- 20      preferably arranged so that highest and lowest audio frequencies are predominantly in the central region of the display, while the intermediate frequencies are predominantly represented by lamps producing images in the outer regions of the display or distributed over the
- 25      area of the display. Preferably the lamps incorporating said elements are used predominantly for the middle to higher range of audio frequencies, and lamps producing other images are used for the lower frequency range and possibly also for the highest frequency range. Preferably
- 30      also the lamps are arranged in at least two rows at different distances from the surface of the screen.

35      The filter units of the system can be arranged so that the audio frequency response of adjacent channels overlap each other, preferably to produce as nearly as practicable a smooth response over the audio frequency spectrum.



## 3.

- The system may include an amplifier unit arranged to vary the intensity of illumination in response to the amplitude of the audio input signal. There may also be an automatic gain control to limit the output signal to
- 5 the lamps and compensate for non-linear response of the lamps to variations in current. Additionally or alternatively the amplifier may have a logarithmic response, arranged to compress the dynamic range of the audio signal.
- 10 There may also be provided a limited amount of background illumination on the screen, so that the images do not appear on a totally dark background. The apparatus may therefore include a lamp providing an overall relatively low level of illumination of the
- 15 screen.

In order that the invention may be more clearly understood, various embodiments will now be described with reference to the accompanying drawings, wherein:

- 20 Fig. 1 shows a perspective view of the display part of one embodiment of the apparatus, as seen by a viewer;

Fig. 2 shows a perspective view of part of the rim of the display screen of Fig. 1;

- 25 Fig. 3 (a) to (d) shows different sorts of lamp housings;

Fig. 4 shows a diagrammatic cross-sectional view of an alternative form of screen; and

Fig. 5 is a schematic diagram of electronic circuitry for the apparatus.

- 30 Referring to the drawings, and firstly to Fig. 1, the screen comprises a shallow dome 14, which is arranged horizontally above the viewer; for example, it may be set in the ceiling of a room or suspended from the ceiling. The dome is preferably of parabolic curvature. An
- 35 upwardly opening trough 15 extends around the periphery



of the dome, and in a sector of the trough (marked A-A in Fig. 1) are mounted the lamps.. Typically, this sector may extend around one third of the circumference. The trough thus prevents the lamps from being seen directly 5 by the viewer, but its open top allows the light to be projected onto the screen. Well below the dome there may be provided a lamp 16 on a stand 17, arranged to throw a circular pool of light over the area of the dome. However this feature is optional and may be omitted if 10 desired. It is intended to provide a very low level of illumination of the dome when the sound signal is zero.

Referring to Fig. 2, the lamps 18 are arranged in the trough in three rows X, Y and Z, at different distances from the surface of the dome. Those nearest 15 the surface, in row X, direct their light across the surface of the dome, producing elongate images, whereas those furthest from the surface, in row Z, direct their light at the surface of the dome producing more localised and sometimes sharper images.

20 Fig. 2 shows various sorts of lamp housing which are more particularly illustrated in Fig. 3. In Fig. 3(a) the bulb 19 is carried in a conventional holder 20 which can be mounted within the trough 15 using suitable brackets (not shown). A cylindrical housing 20 fits 25 slidably over the bulb. The sides of the housing are opaque, but the end 21 is open or covered by a light transmitting sheet, which can be coloured (if the bulb itself is not coloured) so that an unfocussed shaft of coloured light emerges from the end 21. Fig. 3(b) shows 30 an alternative housing in which the end 21 is closed by a wall having an aperture in which is fitted one or more light-transmitting elements 22 of coloured glass, crystal or gemstone. Gemstones are preferred because 35 they have internal striations which provide distinct patterns on the surface of the dome. Typical gemstones



## 5.

for this purpose are ruby, topaz, aquamarine, alexandrite, amethyst, garnet, peridot, spinel, sapphire and emerald. The stones are preferably cut and may be mounted with the flat face outwards or inwards to give different effects.

5 Fig. 3(c) shows an alternative housing in which the end 21 is closed and narrow slots 23 or other small openings are provided in the walls giving relatively narrow beams of light. Fig. 3(d) shows an alternative housing in which the end 21 is closed and a relatively large opening 10 24 is provided in the side wall to give a more diffuse beam of light. The lamps are arranged at various angles in the trough 15, as suggested in Fig. 2, to give desired images on the surface of the dome. The housings can be rotated to adjust the images.

15 The electronic circuitry for controlling the lamps 18 in accordance with an audio input signal can be generally conventional. A suitable arrangement is shown in Fig. 5. The audio signal (e.g. from a gramophone, tape recorder, radio or microphone) is supplied at an 20 input 30 to a preamplifier 32, which has a logarithmic response in order to compress the dynamic range of the audio signal, so that a pleasing display is seen for both loud and quiet inputs, and to limit the output to the lamps and to account for non-linear response of the 25 lamps to variations in current. Additionally or alternatively, the preamplifier 32 may have an automatic gain control for similar reasons.

The audio signal is now split into a plurality of parallel channels, each sensitive to a particular 30 frequency band. The number of channels can vary. For example, there may be twelve channels, each driving several of the lamps. The best results are obtained, however, with a large number of channels, such as forty-eight, each responsive to only a comparatively narrow band of 35 the audible spectrum and each driving only one or perhaps



## 6.

two of the lamps. Each channel has a filter 36 by means of which the frequency band to which that channel is responsive is set. Where there is a large number of channels, the bandwidth of a channel is preferably 5 relatively narrow, and some or all channels may respond to only one or two notes of the musical scale. However, advantageously the bandwidth is a little wider than about a semitone or tone, to allow for variations in the accuracy of tuning of the input signal. A bandwidth 10 of 1/8 octave may be suitable. Preferably the response of the filter falls away sharply at the edges of the desired frequency band, and preferably there is a slight overlap between adjacent frequency bands.

From these requirements, clearly a filter with a 15 high value of Q is desirable. A particularly suitable filter is the type known as "state variable", which is described in an article on page 62 of the magazine Electronics Today International, June 1976. A Motorola MC3403 Quad operational amplifier integrated circuit was 20 used in this embodiment. The exact parameters of the filters can be variable, to permit presetting of the system to give best results.

The filter 36 is preceded by an amplifier 34. The gain of this amplifier is variable so that the overall 25 level of the lamps driven by each channel can be preset. The filter is followed by an AC to DC converter 37, which rectifies the audio signal to give a DC signal dependent on the amplitude of the audio signal. This DC signal controls the length of the unstable period of a 30 monostable 38, which acts on a triac lamp control circuit 42 through a trigger amplifier 40 in well known manner. The triac supplies current to the lamp for a proportion of the mains AC cycle which is controlled by the duration of the unstable period of the monostable. The 35 brightness of each lamp 18 thus varies with the amplitude of the audio signal in the corresponding



channel.

A rough indication of the kind of display produced is shown at 16 in Fig. 1. The beams of light emanate from the sector of the dome periphery opposite the viewer and spread out across the dome in patterns determined by the type and arrangement of lamp housings used and the nature of the sound input. At low volume, the images are concentrated near the source of the lights, and as the sound dies away the images seem to 5 disappear into the edge of the dome. Housings of Fig. 3(b) type are generally used for the middle and higher frequencies, usually in rows Y and Z to produce relatively sharp images of interesting patterns, whereas Figs. 3(a), (b) and (d) type lamps are generally used 10 for the lower frequencies and may also be used for the highest audible frequencies. In this way, the sharpest images are produced with the most distinctly audible 15 notes. Also, the highest and lowest frequencies are represented by images predominantly in the central region of the array of lamps, while the middle range of 20 frequencies is represented by images in the outer regions or distributed across the screen.

The screen could be of various other concave shapes, for example that of a shell. The concavity of 25 the surface (i.e. curving concavely in all directions) provides a more even illumination within each image. That is, the decrease in intensity of illumination is less dependent on the distance from the lamp source 30 than would be the case with a flat screen. The concave screen can be arranged to be mounted in any desired position. For example the screen could be mounted in the angle between the ceiling and wall of a room, especially between the two speakers of a stereophonic 35 sound reproduction system. In this case the lamps could be arranged so that images appear more on one side than



8.

the other according to which direction the sound appears to be coming from. Particular filter channels could thus be linked to different channels of the stereo system, for example, a 48-filter channel system having 24 filter channels for each stereo channel. Other arrangements of screen are between the angle of the ceiling and two walls, on one wall or in the angle between two walls, in the angle between two walls and the floor, or even on the floor facing upwardly. Use could even be made of the existing walls or ceiling by providing a relatively small or narrow concave screen and allowing the images to spill over onto the wall or ceiling. One particular alternative type of screen is shown in cross-section in Fig. 4. The screen takes the form of a bowl 25 of spherical or parabolic shape, having a boss 26 at the centre in which are mounted the lamps 18 so as to project light outwardly from the centre across the screen, either in all directions or with a bias in some directions, perhaps according to frequency. A cap 27 projects radially beyond the boss so that the lamps themselves are not normally visible. This unit could be mounted to the ceiling or wall of a room.

Various controls can be provided on the equipment for operation by the user, for example the equivalent of volume, treble and bass controls for the lighting, so that the general intensity of the lighting can be altered using the "volume" control, and the light intensity response at high and low frequencies can be altered using the "treble" and "bass" controls. Further, a control may be provided to alter the linearity of the light response. Also a bandwidth control may be provided to spread or reduce the band width of each channel, so that a channel may respond to a single note or to a number of notes. Furthermore, a bandswitch control may be provided so that the lights can be switched from one channel to another. In this way



9.

the frequencies represented by the different lamps can be changed, giving a totally different sequential display from a given audio performance.

Another feature is to provide a manual control  
5 which can be operated to provide an input progressing steadily across the audio frequency range so that the operation of the lamps can be checked before the performance. An automatic sweep oscillator can be provided to give, on selective operation or automatically  
10 after termination of a performance, a randomly or pseudo-randomly changing frequency input to provide a changing output from the lights, for example when there is no performance taking place.



10.

CLAIMS:

1. An audio-visual display system comprising a plurality of channels each having a filter unit (36) to provide an electrical output signal in response to a selected band of audio-frequency input, the different channels being responsive to different bands and connected to different lamps (18) or sets of lamps which are arranged to project different images on a screen (14), whereby the different images are produced in response to variations in audio-frequencies supplied to the filter units, the screen being concave and the lamps being arranged to project the images across the concave surface.
2. An audio-visual display system according to claim 1 wherein the lamps project the images from the periphery of the screen.
3. An audio-visual display system according to claim 2 wherein the lamps are arranged around a sector (A-A) of the periphery, whereby the images appear to emanate from that sector.
4. An audio-visual display system according to claim 1 wherein at least some of the lamps (18) incorporate non-laminar coloured light-transmitting elements (22) through which the light passes so as to provide coloured patterned images by refraction or from natural internal striations in the element.
5. An audio-visual display system according to claim 4 wherein at least some of said non-laminar elements are of glass, crystal or gemstones.
6. An audio-visual display system according to claim 4 or claim 5 comprising a first set of lamps incorporating said non-laminar elements, and a second set of lamps providing a relatively diffuse image by transmission of light through coloured laminar filters.
7. An audio-visual display system according to claim 4



11.

comprising a set of lamps which provides coloured light emanating from one or more openings (23) in a generally opaque lamp housing, the openings being small in relation to the lamp so as to provide relatively narrow beams of  
5 light.

8. An audio-visual display system according to claim 4 wherein lamps incorporating said non-laminar elements are used predominantly for the middle to higher range of audio-frequencies, and lamps producing other images are  
10 used for the lower frequency range and optionally also for the highest frequency range.

9. An audio-visual display system according to claim 1 wherein the lamps are arranged so that those representing the highest and lowest audio-frequencies are predominantly  
15 in the central region of the display, while the intermediate frequencies are predominantly represented by lamps producing images in the outer regions of the display or distributed over the area of the display.

10. An audio-visual display system according to claim 1  
20 wherein the lamps are arranged in at least two rows (X,Y,Z) at different distances from the surface of the screen.

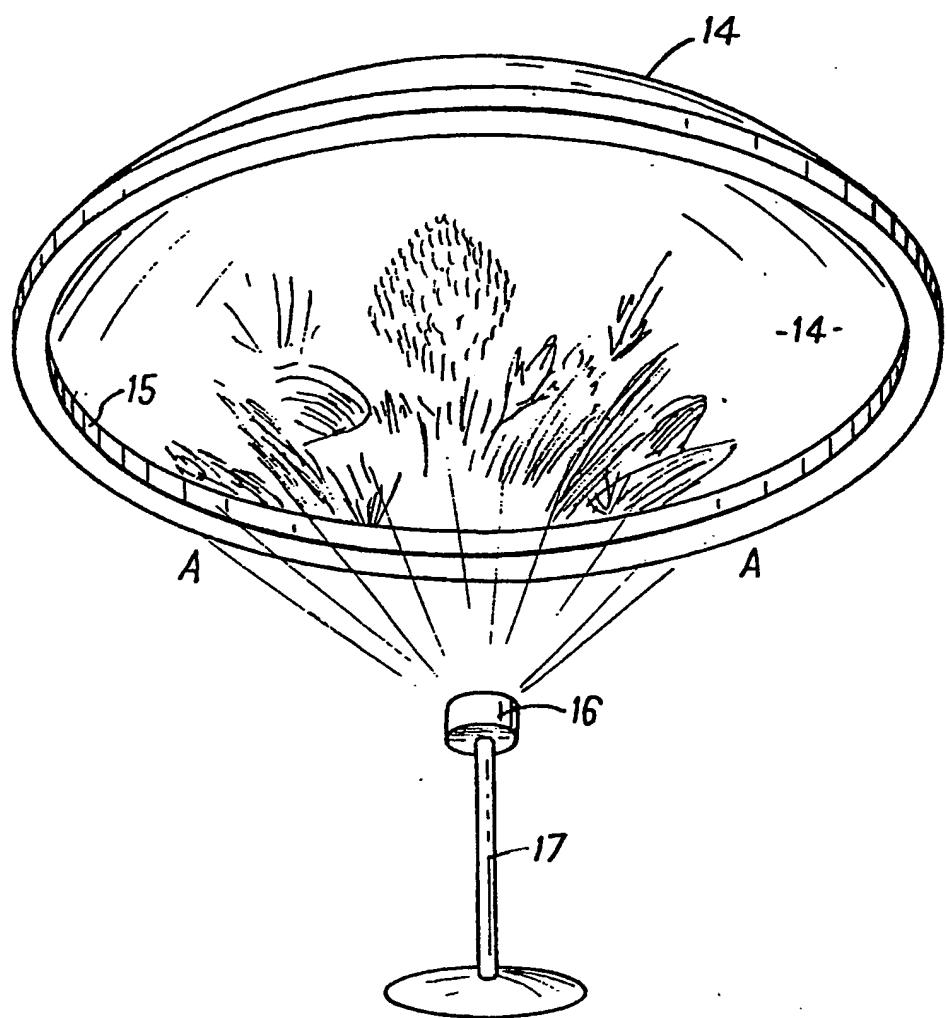
11. An audio-visual display system according to claim 1  
25 wherein said filter units are arranged so that the audio-frequency response of adjacent channels overlap each other.

12. An audio-visual display system according to claim 1 including an amplifier (32) arranged to vary the intensity of illumination in response to the amplitude of the  
30 audio input signal.



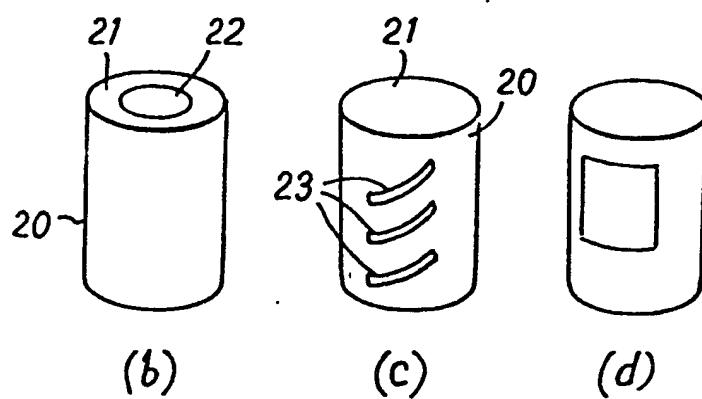
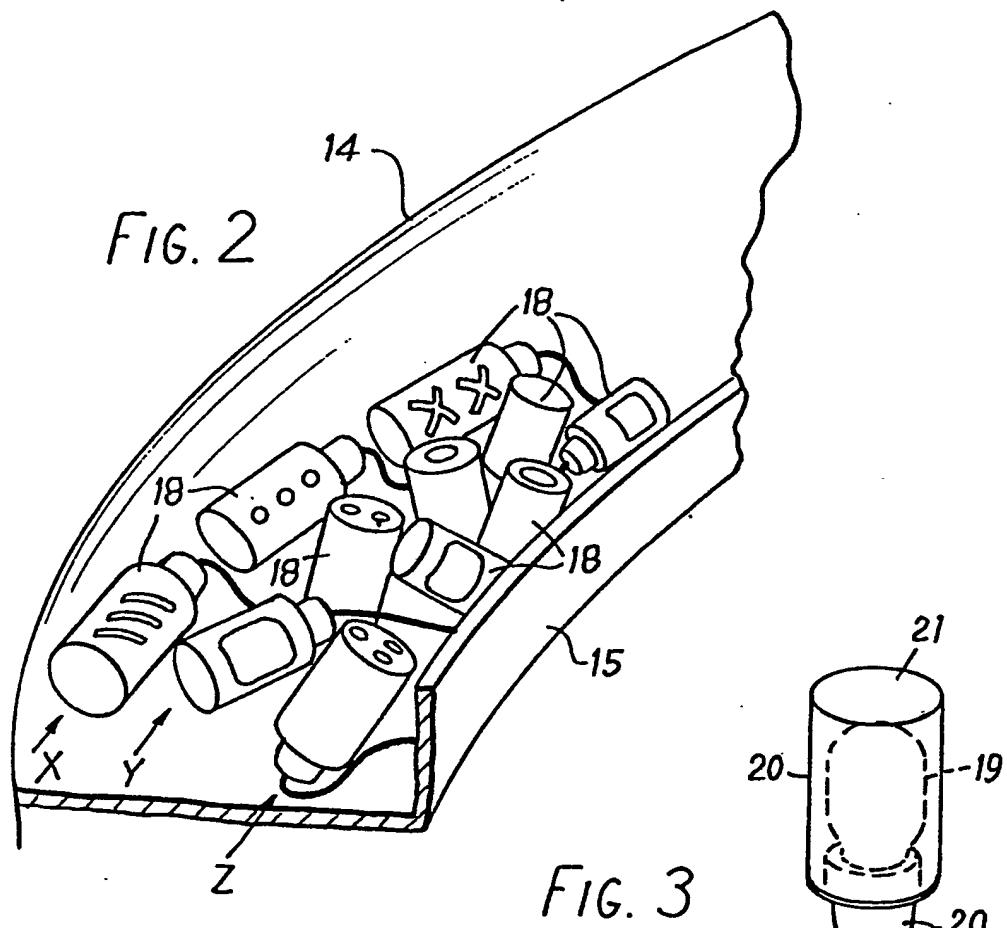
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FIG. 1

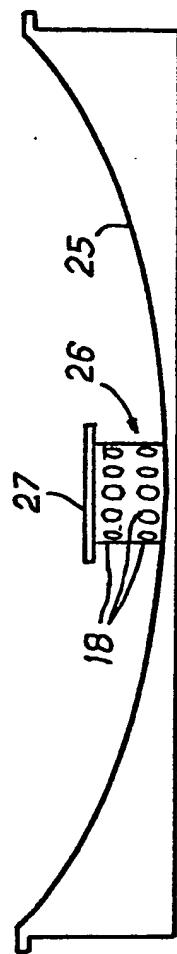
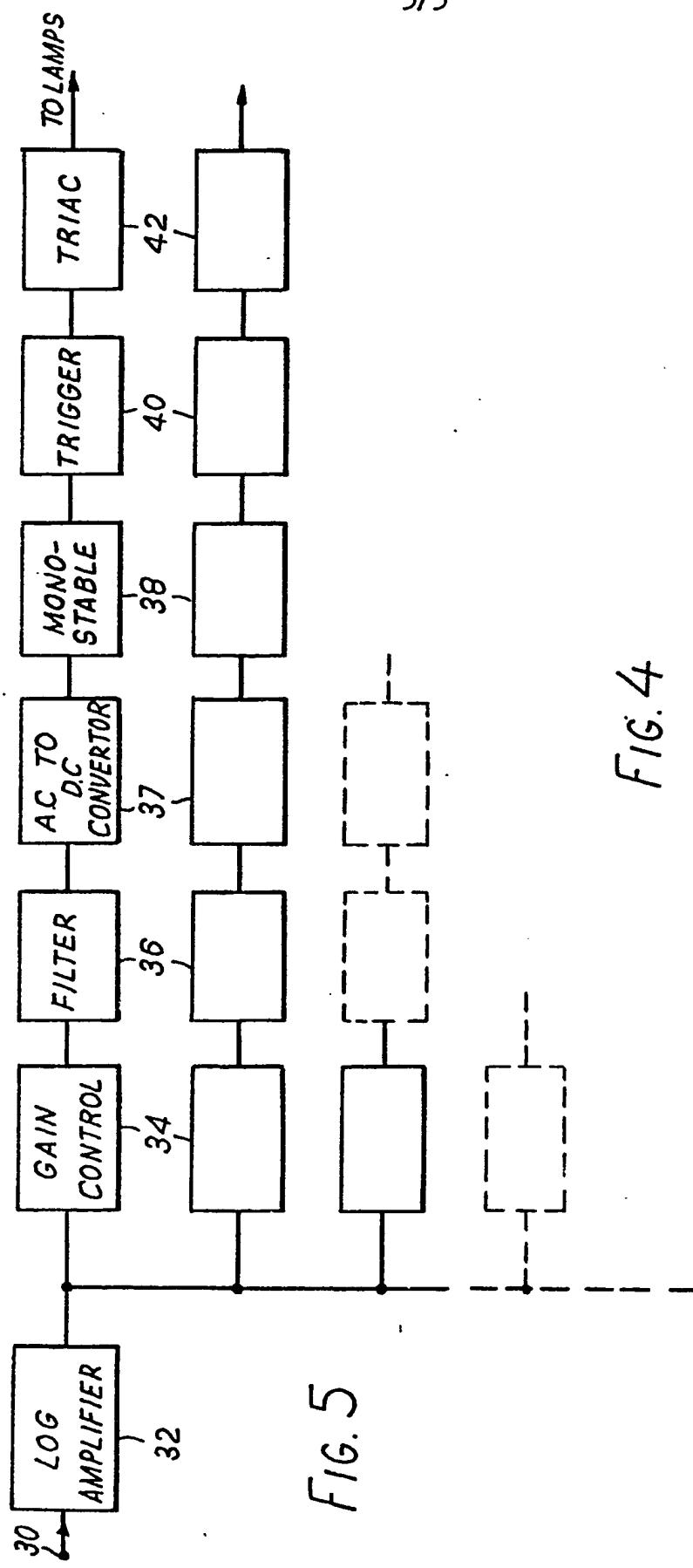


2/3

FIG. 2



3/3



# INTERNATIONAL SEARCH REPORT

International Application No. PCT/GB 79/00201

## I. CLASSIFICATION OF SUBJECT MATTER (If several classification symbols apply, indicate all) <sup>3</sup>

According to International Patent Classification (IPC) or to both National Classification and IPC

Int. Cl. <sup>3</sup> F 21 P 3/00; A 63 J 17/00; G 09 F 27/00

## II. FIELDS SEARCHED

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Classification System	Classification Symbols
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Documentation Searched other than Minimum Documentation  
to the Extent that such Documents are Included in the Fields Searched <sup>5</sup>

## III. DOCUMENTS CONSIDERED TO BE RELEVANT <sup>16</sup>

Category <sup>17</sup>	Citation of Document, <sup>18</sup> with indication, where appropriate, of the relevant passages <sup>17</sup>	Relevant to Claim No. <sup>19</sup>
	GB, A, 968822, published September 2, 1964 see page 2, lines 19-56, page 3, lines 54-68, figures 1-3, Cramer --- US, A, 3958113, published May 18, 1976 see column 5, lines 13-30, figure 3, Termohlen --- US, A, 3806722, published April 23, 1974 see column 2, lines 17-55, figure 3, Peake --- FR, A, 2232171, published December 27, 1974 see page 1, lines 20-30, page 3, lines 13-18, Silbermann --- US, A, 4164823, published August 21, 1979 see column 2, lines 20-24, Marsico --- US, A, 1977997, published October 23, 1934 see page 1, lines 102-107, page 2, lines 116-121, figure 1, Patterson -----	1, 3, 11 1, 11, 12 1, 2, 5 1, 4, 12 1, 10 2, 4, 5, 12

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"X" document of particular relevance

## IV. CERTIFICATION

Date of the Actual Completion of the International Search <sup>20</sup>

July 16, 1980

Date of Mailing of this International Search Report <sup>20</sup>

July 25, 1980

International Searching Authority <sup>21</sup>

European Patent Office

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